

PATENT ABSTRACTS OF JAPAN

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(54) INK-JET RECORDING INK

(57) Abstract:

PROBLEM TO BE SOLVED: To provide an ink-jet recording ink capable of reducing color breed while suppressing feathering even when recorded on an ordinary paper.

SOLUTION: The ink-jet recording ink at least comprises water colorants, water soluble organic solvent and a compound represented by general formula (1): $RN(CH_2CH_2O)_xH(CH_2CH_2O)_yH$ (wherein R represents an 8-18C alkyl group and x+y is 10 or less) and having a surface tension of 31-35 mN/m.

CLAIMS

[Claim(s)]

[Claim 1] Ink for ink jet recording which contains at least watercolorants, water soluble organic solvent and a compound expressed with a following general formula (1) and is characterized by surface tension being 31 - 35 mN/m.



R expresses an alkyl group of the carbon numbers 8-18 among a formula and x+y is ten or less.

[Claim 2]The ink for ink jet recording containing polyoxy-alkylene-glycol n-alkyl ether according to claim 1.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the ink for record used for an ink jet printer.

[0002]

[Description of the Prior Art]By making the system and ink which give mechanical oscillation or displacement to ink using an electrostatic suction methoda piezoelectric deviceetc. as an ink jet recording method heat conventionallyair bubbles are generated and ink discharge systemssuch as a method of using the pressure at that timeare known. An ink glob is formed with these regurgitation systemsand it records by making those parts or all adhere to recorded materialssuch as paper. The thing which made the liquid medium which consists of water or waterand a water soluble organic solvent dissolve or distribute various kinds of water soluble dye or paints as ink used for such an ink jet recording method is known and used.

[0003]In order to perform good record over a long time using such inkIn order to prevent blinding by that weighted soliditysuch as viscosity of the ink to be usedsurface tensionconductivityand densityis suitable valuesthe nozzle of recording equipmentand an orificeConditionslike that a sludge does not arise with heat etc. or a property value does not change and the recorded image is excellent in a water resisting propertylightfastnessetc. are required. Much proposals are made in order to satisfy these conditions.

[0004]Howeverthe recording request to the regular paper is increasing rather than recording on an ink jet dedicated paper from consideration of cost and environment in recent years. In much conventional inkwhen it recorded on a regular paperit was easy to generate the color bleeding started by being mixed in a blot (feathering) of an ink edge part and the portion which different colors adjoinand there was a problem that print quality deteriorated as a result.

[0005]Although the method of lowering the surface tension of inkand ink

sinking in as feathering and a method of preventing generating of color bleeding and raising speed can be mentioned. The method of using an acetylene glycol which is being described at JPH5-293976A as such a method is proposed. However the surface tension of ink will be adjusted to 30 or less mN/m by addition of the optimum dose of this substance. At the time of the head regurgitation the ink such whose surface tension is too low may cause degradations such as impact accuracy and it not only increases the blot in the paper but it may reduce the reliability of a discharging mechanism.

[Problem to be solved by the invention]

[0006] This invention is made in order to solve the problem mentioned above and an object of this invention is to provide the ink for ink jet recording which can reduce color bleeding controlling feathering even if it uses for record in a regular paper.

[0007]

[Means for solving problem] This invention contains at least watercolorant and a water soluble organic solvent and the compound expressed with a following general formula (1) and surface tension is ink for ink jet recording which is 31 - 35 mN/m.



R expresses the alkyl group of the carbon numbers 8-18 among a formula and x+y is ten or less. In this Description surface tension means the value measured in 25 **. This invention is explained in full detail below.

[0008] The ink for ink jet recording of this invention contains watercolorant and a water soluble organic solvent at least. Although not limited especially as water used by this invention it is preferred to use what has the high purity of ion exchange water such as tap water distilled water etc. Although what is necessary is just to determine the content of the above-mentioned water depending on the kind of the above-mentioned colorant and water soluble organic solvent and the characteristic of the ink for which it composes or asks it is preferred that it is generally 10 to 98 weight % to the full weight of ink. If the regurgitation from a head becomes ink viscosity becomes it high that it is less than 10 weight % too much and difficult and it exceeds 98 weight % it will be ink which is easy to dry. More preferably it is 30 to 97 weight % and is 40 to 95 weight % still more preferably.

[0009] As colorant used by this invention a color paint setc. can be used for example. As the above-mentioned color the water soluble dye represented by a direct color acid dye a basic stain reactive dye etc. is used. Although not limited especially as the above-mentioned water soluble dye are

suitable for the ink used for an ink jet recording method what fills the performance as which clear naturewater solubility stability light fastness and others are required is preferred for example C. The I. direct blacks 1719325171108146 and 154168; C. I. direct blue 62225718690 and 106 the 199; C. I. Daillekh treads 141728 and 83227; C. The I. direct yellow 1224268698 and 132 the 142; C. I. direct oranges 343944 and 46 the 60; C. I. direct violet 4748; C. I. direct Brown 109; C. I. direct green 59; C. The I. acid blacks 272426315263 and 112 the 118; C. I. acid blues 922405993102104113117120167 and 229 the 234; C. I. acid red 163237 and 51528085879294115181256289315 the 317; C. I. acid yellow 1117 and 232529426171; C. The I. acid orange 719; C. I. acid violet 49; C. I. basic black 2; C. The I. basic blues 13579242526 and 28 the 29; C. I. basic red 1291213 and 14 the 37; C. I. basic violet 7 and 14 the 27; C. I. food black 1 and 2 grades can be mentioned.

[0010] It will not be limited especially if distribution to aqueous phase is possible as the above-mentioned paints. For example azo pigment such as an azo rake insoluble azo pigment a disazo condensation pigment and a chelate azo pigment; A phthalocyanine pigment Perylene perinon paints anthraquinone paints a quinacridone pigment Polycyclic type paints such as dioxazine paints thioindigo paints an isoindolinone pigment and quinophthalone paints; A basic stain type rake Color rakes such as an acid dye type rake; inorganic pigment such as organic color; titanium oxides such as nitro paints nitroso paints and an aniline black daylight illuminant fluorescent pigment iron oxide system paints and carbon black system paints can be mentioned. It is also possible to use what carried out the surface treatment of the various above-mentioned paints with a surface-active agents polymer dispersing agent etc. as paints used by this invention. As such a thing graft carbon can be mentioned for example.

[0011] When using the above-mentioned paints as colorant used by this invention distributed processing is performed by a method conventionally known with other additive agents a suitable dispersing agents solvent pure water and if needed. As the above-mentioned dispersing agents polymer dispersing agent and a surface-active agent which are used for pigment dispersion indicated to JPS62-101672A for example can be used. It is not limited especially as the above-mentioned polymer dispersing agent but for example protein; gum arabic such as gelatin and albumin crude rubber [such as tragacanth gum]; — glucoside [such as saponin]; — methyl cellulose. Cellulosics such as carboxymethyl cellulose and hydroxymethyl cellulose; A ligninsulfonic acid salt naturally occurring polymers such as shellac; Polyacrylate salt of a styrene acrylic acid-

copolymerization thingA salt of a vinylnaphthalene-acrylic-acid-copolymerization thinga salt of styrene maleic acid copolymerAnionic polymerssuch as a salt of vinylnaphthalene-maleic acid copolymersodium salt of beta-naphthalene sulfonic acid HORMARIN condensateand an phosphate; nonionic polymerssuch as polyvinyl alcohola polyvinyl pyrrolidoneand a polyethylene glycoetc. can be mentioned.

[0012]As the above-mentioned surface-active agentfor example Fatty alcohol sulfate. Anionic surfactantssuch as liquid fatty oil sulfuric ester salt and alkyl allylsulfonates; Polyoxyethylene alkyl estersorbitan alkyl esterand polyoxyethylene sorbitan alkyl esteretc. can be mentioned. These dispersing agents may be used independently and two or more sorts may be used together. As for the loadings of the above-mentioned dispersing agentit is preferred that it is generally 0.01 to 20 weight % to the full weight of ink. If effectssuch as adjustment of surface tensiondo not fully show up that it is less than 0.01 weight % but it exceeds 20 weight %evilssuch as the rise of an effect not only not being seen but an increase in ink viscositywill happen.

[0013]Although it is not limited but a common dispersion machine can be widely used especially as a dispersion machine used for the distributed processing of the above-mentioned paintsa ball milla roll milla sand millleic. can be mentionedfor example. Especiallya high-speed type sand mill is preferred. The above-mentioned color and paints may be used independentlyrespectivelyand colorspaintsand two or more sorts of colors and paints are mixedand they may be used. As for the content of the above-mentioned colorant is preferred that it is generally 0.1 to 20 weight % to the full weight of ink. When it cannot fully color to a regular paper that it is less than 0.1 weight % but exceeds 20 weight %a deposit of colorant and condensation may take place in ink. More preferablyit is 0.3 to 15 weight %and is 0.5 to 10 weight % still more preferably.

[0014]It is not limited especially as a water soluble organic solvent used by this invention. For examplemethyl alcholethyl alcoholn-propyl alcoholThe alkyl alcohol of the carbon numbers 1-5 of n-butyl alcohol etc.; DimethylformamideAmidesuch as dimethylacetamide; Ketone or keto alcohol: tetrahydrofuranssuch as acetone and diacetone alcoholEthersuch as dioxane; Ethylene glycolpropylene glycolAlkylene group **** alkylene-glycols; glycerin of the carbon numbers 2-6such as triethylene glycol and a diethylene glycol; A polyethylene glycolPolyalkylene glycolssuch as a polypropylene glycol; Ethylene glycol monomethyl (or ethyl) etherDiethylene-glycol monomethyl (or ethyl) etherlow-grade monoalkyl

ether [of polyhydric alcohols such as triethylene glycol monomethyl (or ethyl) ether]; — low-grade dialkyl ether [of polyhydric alcohols such as triethylene glycol dimethyl (or ethyl) ether]; — sulfolane and a pyrrolidone, N-methyl-2-pyrrolidone13-dimethyl-2-imidazolidinone15-pentanediol etc. can be mentioned. These may be used independently and two or more sorts may be used together. Although what is necessary is just to determine a compounding ratio in the wide range depending on the characteristic of ink of composing or asking for ink when using together two or more kinds of water soluble organic solvents the compounding ratio in the case of using together two kinds of water soluble organic solvents is weight conversion it is preferred that it is generally 0:100-40:60 and they are 5:95-30:70 more preferably.

[0015] Ink for ink jet recording of this invention contains a compound expressed with the above-mentioned general formula (1) as an essential ingredient in addition to watercolorant and a water soluble organic solvent. It differs from a case where an acetylene glycol is used by using a compound expressed with the above-mentioned general formula (1). It can adjust to 31 which is a range which can reduce color bleeding - 35 mN/m controlling feathering even when surface tension of ink is used for a regular paper.

[0016] In the above-mentioned general formula (1) R is an alkyl group of the carbon numbers 8-18. A way which has width in a carbon number of an alkyl group has the stability as a substance. Preferably they are the carbon numbers 12-18. x and y express the number of structural units and $x+y$ is ten or less. If chain length of a polyoxyethylene group becomes long too much it will become impossible to lower surface tension of ink and deterioration of print quality will occur. Preferably $x+y$ is 2-7.

[0017] As a compound expressed with the above-mentioned general formula (1) ESOMIN C12C15T12T15S12S15O12 (made by a Iion company) etc. can be used for example. Especially ESOMIN C12 and C15 are used suitably.

[0018] As for content of a compound expressed with the above-mentioned general formula (1) it is preferred that it is 0.01 to 5 weight % to full weight of ink. When surface tension of ink is too high when it is less than 0.01 weight % and color bleeding may arise and it exceeds 5 weight % since surface tension of ink becomes low too much ink sinks in and speed is too quick and may produce feathering. It is 0.1 to 3 weight % more preferably.

[0019] Surface tension of ink for ink jet recording of this invention is 31 - 35 mN/m. Concentration too strong penetrating power to paper in their being less than 31 mN/m and sufficient as a picture cannot be secured and the reliability of a projection mechanism cannot fully be

secured either. On the other hand if 35 mN/m is exceeded devils like in an effect which carries out the body to color bleeding drying time in the record paper of ink becomes low for a long time will come out.

Preferably it is 32 - 34 mN/m. The ink for ink jet recording of this invention can adjust surface tension to 31 - 35 mN/m by content of a compound expressed with the above-mentioned general formula (1).

[0020] Ink for ink jet recording of this invention may contain polyoxy-alkylene-glycol n-alkyl ether. That whose carbon number of an oxyalkylene group or carbon number of an alkyl group is five or less and is 12 or less as polyoxy-alkylene-glycol n-alkyl ether used by this invention is preferred. A rise of viscosity is intense and a long thing of a chain of a molecule is not suitable as a material of ink for ink jet recording.

[0021] As the above-mentioned polyoxy-alkylene-glycol n-alkyl ether glycol ether represented by alkyl ether of an ethylene glycol system and a propylene glycol series can be mentioned.

[0022] As the above-mentioned ethylene glycol system compound for example Ethylene glycol n-methyl ether Ethylene glycol n-ethyl ether ethylene glycol n-propyl ether Ethylene glycol n-butyl ether ethylene glycol n-isobutyl ether Diethylene glycol n-methyl ether Diethylene glycol n-ethyl ether Diethylene glycol n-propyl ether Diethylene glycol n-butyl ether Diethylene glycol n-isobutyl ether triethylene glycol n-methyl ether triethylene glycol n-ethyl ether triethylene glycol n-propyl ether triethylene glycol n-butyl ether triethylene glycol n-isobutyl ether etc. can be mentioned.

[0023] As the above-mentioned propylene glycol series compound for example propylene glycol n-methyl ether propylene glycol n-ethyl ether Propylene glycol n-propyl ether propylene glycol n-isopropyl ether Propylene glycol n-butyl ether dipropylene glycol n-methyl ether Dipropylene glycol n-ethyl ether dipropylene glycol n-propyl ether Dipropylene glycol n-isopropyl ether dipropylene glycol n-butyl ether Tripropylene glycol n-methyl ether tripropylene glycol n-ethyl ether Tripropylene glycol n-propyl ether tripropylene glycol n-isopropyl ether tripropylene glycol n-butyl ether etc. can be mentioned.

[0024] Ink for ink jet recording of this invention may contain various publicly known dispersing agents a surface-active agent a viscosity controlling agent a surface tension regulator a pH adjuster an antiseptic and mildewproofing agent etc. if needed in addition to this conventionally. When ink for ink jet recording of this invention is used for an ink jet recording method of a type which electrifies recording inks specific resistance regulator such as mineral such as a lithium

chlorideammonium chlorideand sodium chloridemay be contained. When ink for ink jet recording of this invention is used for an ink jet system of a type which makes ink breathe out by operation of thermal energythermal property valuessuch as specific heata coefficient of thermal expansionand heat conductivitymay be adjustedfor example.

[0025]A problem of conventional technology is fully solvedfeathering in an ink jet system and color bleeding are reducedand the ink for ink jet recording of this invention produced by making it above can give clear color recording also in a regular paper.

[0026]

[Working example]Although an embodiment is hung up over below and this invention is explained to it in more detailthis invention is not limited only to these embodiments.

[0027]

(Embodiment 1)

the amount of <black ink presentation> C.I. direct black 154 duplexs -- the compound ($R=C_{8-18}$) expressed with an amount part glycerin of part C.I. direct black 19 duplexs 23 weight-section general formula (1) $x+y=5$ 0.8 weight-section pure water The surface tension of total-residues 100 weight-section black ink was 34.2 mN/m. The surface tension balance by a harmony interface science company was used for surface tensionand it measured at the room temperature of 25 **. In the following embodiments and comparative examplesit measured similarly.

[0028]

Compound ($R=C_{8-18}$ $x+y=5$) 0.8 weight-section pure water expressed with an amount part glycerin of <cyan ink presentation> C.I. direct blue 199 duplexs 25 weight-section general formula (1) The surface tension of total-residues 100 weight-section cyan ink was 34.2 mN/m.

[0029]

<A magenta ink presentation> Compound ($R=C_{8-18}$ $x+y=5$) 0.5 weight-section pure water expressed with an amount part glycerin of C.I. Dailekh tread 80 duplexs 25 weight-section general formula (1) Surface tension of total-residues 100 Weight-section MagentalInc. was 34.1 mN/m.

[0030]

<A yellow ink presentation> Compound ($R=C_{8-18}$ $x+y=5$) 0.5 weight-section pure water expressed with an amount part glycerin of C.I. direct yellow 142 duplexs 25 weight-section general formula (1) Surface tension of total-residues 100 weight-section yellow ink was 34.4 mN/m.

[0031]

(Embodiment 2)

the amount of <black ink presentation> C.I. direct black 154 duplexs --

the compound ($R=C_{9-18}$) expressed with an amount part glycerin of part C.I. direct black 19 duplexs 23 weight-section general formula (1) $x+y=2$ 0.3 weight-section pure water The surface tension of total-residues 100 weight-section black ink was 33.9 mN/m.

[0032]

Compound ($R=C_{9-18}$, $x+y=2$) 0.3 weight-section pure water expressed with an amount part glycerin of <cyan ink presentation> C.I. direct blue 199 duplexs 25 weight-section general formula (1) The surface tension of total-residues 100 weight-section cyan ink was 33.8 mN/m.

[0033]

<magenta ink presentation> Compound ($R=C_{9-18}$, $x+y=2$) 0.1 weight-section pure water expressed with an amount part glycerin of C.I. Dailekh tread 80 duplexs 25 weight-section general formula (1) The surface tension of total-residues 100 weight-section Magentalnc. was 34.2 mN/m.

[0034]

<yellow ink presentation> Compound ($R=C_{9-18}$, $x+y=2$) 0.1 weight-section pure water expressed with an amount part glycerin of C.I. direct yellow 142 duplexs 25 weight-section general formula (1) The surface tension of total-residues 100 weight-section yellow ink was 33.8 mN/m.

[0035]

(Embodiment 3)

the amount part of <black ink presentation> C.I. direct black 154 duplexs C.I. direct black 19 -- the compound ($R=C_{9-18}$) expressed with an amount part glycerin of duplexs 18 weight-section triethylene glycol n-butyl ether 5 weight-section general formula (1) $x+y=5$ 0.5 weight-section pure water The surface tension of total-residues 100 weight-section black ink was 32.3 mN/m.

[0036]

the <cyan ink presentation> C.I. direct blue 199 -- the compound ($R=C_{9-18}$) expressed with an amount part glycerin of duplexs 20 weight-section triethylene glycol n-butyl ether 5 weight-section general formula (1) $x+y=5$ 0.5 weight-section pure water The surface tension of total-residues 100 weight-section cyan ink was 31.9 mN/m.

[0037]

the <magenta ink presentation> C.I. Dailekh tread 80 -- a compound ($R=C_{9-18}$) expressed with an amount part glycerin of duplexs 20 weight-section triethylene glycol n-butyl ether 5 weight-section general formula (1) $x+y=5$ 0.2 weight-section pure water Surface tension of total-residues 100 weight-section Magentalnc. was 31.5 mN/m.

[0038]

the <yellow ink presentation> C.I. direct yellow 142 -- a compound

(R=C₈₋₁₈) expressed with an amount part glycerin of duplex 20 weight-section triethylene glycol n-butyl ether 5 weight-section general formula (1) x+y=5 0.2 weight-section pure water Surface tension of total-residues 100 weight-section yellow ink was 31.4 mN/m.

[0039] (Comparative example 1)

Ink was similarly created except not blending compound 0.8 weight section expressed with a general formula (1) in the black ink of the <black ink> embodiment 1. The surface tension was 59.2 mN/m.

[0040] Ink was similarly created except not blending compound 0.8 weight section expressed with a general formula (1) in the cyan ink of the <cyan ink> embodiment 1. The surface tension was 61.2 mN/m.

[0041] Ink was similarly created except not blending compound 0.5 weight section expressed with a general formula (1) in the magenta ink of the <magenta ink> embodiment 1. The surface tension was 66.7 mN/m.

[0042] Ink was similarly created except not blending compound 0.5 weight section expressed with a general formula (1) in the yellow ink of the <yellow ink> embodiment 1. The surface tension was 69.8 mN/m.

[0043] (Comparative example 2)

Ink was similarly created except having changed compound 0.8 weight section expressed with a general formula (1) in the black ink of the <black ink> embodiment 1 to thing 0.8 weight section of R=C₈₋₁₈ and x+y=15. The surface tension was 36.2 mN/m.

[0044] Ink was similarly created except having changed compound 0.8 weight section expressed with a general formula (1) in the cyan ink of the <cyan ink> embodiment 1 to thing 0.8 weight section of R=C₈₋₁₈ and x+y=15. The surface tension was 38.9 mN/m.

[0045] Ink was similarly created except having changed compound 0.5 weight section expressed with a general formula (1) in the magenta ink of the <magenta ink> embodiment 1 to thing 0.5 weight section of R=C₈₋₁₈ and x+y=15. The surface tension was 37.7 mN/m.

[0046] Ink was similarly created except having changed compound 0.5 weight section expressed with a general formula (1) in the yellow ink of the <yellow ink> embodiment 1 to thing 0.5 weight section of R=C₈₋₁₈ and x+y=15. The surface tension was 37.8 mN/m.

[0047] (Comparative example 3)

Ink was similarly created except having changed compound 0.8 weight section expressed with a general formula (1) in the black ink of the <black ink> embodiment 1 to thing 0.8 weight section of R=C₁₄₋₂₂ and x+y=15. The surface tension was 38.2 mN/m.

[0048] Ink was similarly created except having changed compound 0.8 weight section expressed with a general formula (1) in the cyan ink of

the <cyan ink> embodiment 1 to thing 0.8 weight section of R=C₁₄₋₂₂ and x+y=15. The surface tension was 38.2 mN/m.

[0049]Ink was similarly created except having changed compound 0.5 weight section expressed with a general formula (1) in the magenta ink of the <magenta ink> embodiment 1 to thing 0.5 weight section of R=C₁₄₋₂₂ and x+y=15. The surface tension was 38.4 mN/m.

[0050]Ink was similarly created except having changed compound 0.5 weight section expressed with a general formula (1) in the yellow ink of the <yellow ink> embodiment 1 to thing 0.5 weight section of R=C₁₄₋₂₂ and x+y=15. The surface tension was 37.8 mN/m.

[0051](Comparative example 4)

Ink was similarly created except having changed compound 0.8 weight section expressed with a general formula (1) in the black ink of the <black ink> embodiment 1 to acetylene glycol 0.8 weight section. The surface tension was 29.5 mN/m.

[0052]Ink was similarly created except having changed compound 0.8 weight section expressed with a general formula (1) in the cyan ink of the <cyan ink> embodiment 1 to acetylene glycol 0.8 weight section. The surface tension was 28.8 mN/m.

[0053]Ink was similarly created except having changed compound 0.5 weight section expressed with a general formula (1) in the magenta ink of the <magenta ink> embodiment 1 to acetylene glycol 0.5 weight section. The surface tension was 29.4 mN/m.

[0054]Ink was similarly created except having changed compound 0.5 weight section expressed with a general formula (1) in the yellow ink of the <yellow ink> embodiment 1 to acetylene glycol 0.5 weight section. The surface tension was 29.3 mN/m.

[0055](Quality assessment) After fully carrying out mixed stirring of each material about each ink of Embodiments 1-3 and the comparative examples 1-4 it filtered with a 0.8-micrometer membrane filter and was used for record evaluation.

[0056]These black ink, cyan ink, magenta ink and yellow ink were recorded using MFC-7150C (made by Brother Industries Ltd.). The record sample recorded combining the color that the ink of two colors in which colors differ became a character color and a background color respectively made the evaluation object the blot of an interface and the distinction of a character with which a color is mixed and was taken as the record sample used as the standard of evaluation of the character recorded without each color background. The size of the recorded character set the size of the character as 11 using Microsoft Word 97 and recorded it using the regular paper (Xerox 4200) using MFC-7150C. The record as each color also

with same comparison ink was performed.

[0057] Next the recorded valuation method of a record sample is shown below. The valuation basis carried out visual evaluation of how many characters with a background are blurred as compared with the character without a background. The valuation basis is as follows.

[0058]

0 ... There is almost no color bleeding and there is comparable clearness as compared with a character without a background.

0 ... Although slight color bleeding has occurred as compared with a character without a background a character can fully be deciphered.

** ... A character can be deciphered although color bleeding has occurred clearly as compared with a character without a background.

x ... As compared with a character without a background color bleeding occurs clearly and decipherment of a character is also difficult.

The evaluation result of the record sample which uses each ink was shown in Table 1.

[0059]

[Table 1]

[0060] When the ink of this invention in each embodiment was used most blots by color bleeding were not accepted as shown in Table 1.

[0061]

[Effect of the Invention] It consists of above-mentioned composition in this invention.

Therefore color bleeding can be reduced suppressing feathering even if it records on a regular paper and clear color recording can be performed.